### CP: European Countries/Japan/India/United States/Russia/ Countries ought to produce nuclear power only from Fast Neutron Reactors

### Competition:

The aff advocates for a total prohibition on nuclear power, including the use of fast breed reactors, thus the CP is mutually exclusive.

## Net Benefits:

### Waste

#### Fast Breed Reactors can decrease the lifetime of waste from reactors and increase efficiency, thus reducing the need for more mining. Taebi ‘10

Taebi, B. Philos. Technol. (2011) 24: 169. doi:10.1007/s13347-011-0022-y

Partitioning and Transmutation: In addition to reprocessing, a further deactivating of the remaining waste can be achieved by means of a new method known as Partitioning and Transmutation (P&T). This involves separating and dividing (partitioning) the materials remaining after reprocessing so that they can afterwards be eliminated (transmuted) in Fast Reactors;17 these reactors can irradiate the radionuclides that the currently operational LWR cannot irradiate. This can substantially reduce the waste lifetime to several hundred years (NRC 1996). It is thus a fuel cycle that scores relatively better on the no harm duty scoreboard, as is indicated in Table 1. (4) The Breeder Fuel Cycle: Fast reactors could also be deployed in the configuration of a nuclear breeder for the purposes of making (or breeding) more fuel than is consumed during operation. The best feasible option is to irradiate the abundant uranium isotope (which cannot be irradiated in a LWR) and breed a certain plutonium isotope, which can be extracted by reprocessing, before then reusing it as fuel. In this way, uranium consumption will become substantially more efficient; the two plus signs given in Table 1 indicate that fulfilling the second duty is what is best for this particular fuel cycle. This fuel cycle is designed to enhance the resource durability, and the remaining waste contains very long-lived radionuclides; therefore, it does not score well on the no harm duty.

#### Current fast reactor designs can burn plutonium waste to produce energy, which can solve for nuclear waste issues. Pearce ‘12

Pearce, Fred. "Are Fast-breeder Reactors the Answer to Our Nuclear Waste Nightmare? | Fred Pearce." The Guardian. Guardian News and Media, 2012. Web. 16 Sept. 2016.

And yet, some scientists say, we have the technology to burn plutonium in a new generation of "fast" reactors. That could dispose of the waste problem, reducing the threat of radiation and nuclear proliferation, and at the same time generate vast amounts of low-carbon energy. It sounds too good to be true. So are the techno-optimists right — or should the conventional environmental revulsion at all things nuclear still hold? Fast-breeder technology is almost as old as nuclear power. But after almost two decades in the wilderness, it could be poised to take off. The U.S. corporation GE Hitachi Nuclear Energy (GEH) is promoting a reactor design called the PRISM (for Power Reactor Innovative Small Modular) that its chief consulting engineer and fast-breeder guru, Eric Loewen, says is a safe and secure way to power the world using yesterday's nuclear waste. The stories you need to read, in one handy email Read more The company wants to try out the idea for the first time on the northwest coast of England, at the notorious nuclear dumping ground at Sellafield, which holds the world's largest stock of civilian plutonium. At close to 120 tons, it stores more plutonium from reactors than the U.S. and Russia combined. While most of the world's civilian plutonium waste is still trapped inside highly radioactive spent fuel, much of that British plutonium is in the form of plutonium dioxide powder. It has been extracted from spent fuel with the intention of using it to power an earlier generation of fast reactors that were never built. This makes it much more vulnerable to theft and use in nuclear weapons than plutonium still held inside spent fuel, as most of the U.S. stockpile is. The Royal Society, Britain's equivalent of the National Academy of Sciences, reported last year that the plutonium powder, which is stored in drums, "poses a serious security risk" and "undermines the UK's credibility in non-proliferation debates." Spent fuel, while less of an immediate proliferation risk, remains a major radiological hazard for thousands of years. The plutonium — the most ubiquitous and troublesome radioactive material inside spent fuel from nuclear reactors — has a half-life of 24,100 years. A typical 1,000-megawatt reactor produces 27 tons of spent fuel a year. None of it yet has a home. If not used as a fuel, it will need to be kept isolated for thousands of years to protect humans and wildlife. Burial deep underground seems the obvious solution, but nobody has yet built a geological repository. Public opposition is high — as successive U.S. governments have discovered whenever the burial ground at Yucca Mountain in Nevada is discussed — and the cost of construction will be huge. So the idea of building fast reactors to eat up this waste is attractive — especially in Britain, but also elsewhere. Theoretically at least, fast reactors can keep recycling their own fuel until all the plutonium is gone, generating electricity all the while. Britain's huge plutonium stockpile makes it a vast energy resource. David MacKay, chief scientist at the Department of Energy and Climate Change, recently said British plutonium contains enough energy to run the country's electricity grid for 500 years. Fast reactors can be run in different ways, either to destroy plutonium, to maximise energy production, or to produce new plutonium. Under the PRISM proposal now being considered at Sellafield, plutonium destruction would be the priority. "We could deal with the plutonium stockpile in Britain in five years," says Loewen. But equally, he says, it could generate energy, too. The proposed plant has a theoretical generating capacity of 600 megawatts. Fast reactors could do the same for the U.S. Under the presidency of George W. Bush, the U.S. launched a Global Nuclear Energy Partnership aimed at developing technologies to consume plutonium in spent fuel. But President Obama drastically cut the partnership's funding, while also halting work on the planned Yucca Mountain geological repository. "We are left with a million-year problem," says Loewen. "Right now there isn't a policy framework in the U.S. for solving this issue." He thinks Britain's unique problem with its stockpile of purified plutonium dioxide could break the logjam.

### Sustainability

#### Fast Breed reactors use < 1% of the uranium needed for LWRs, increasing sustainability. Fetter ‘09

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If the Nuclear Energy Agency (NEA) has accurately estimated the planet's economically accessible uranium resources, reactors could run more than 200 years at current rates of consumption. Most of the 2.8 trillion kilowatt-hours of electricity generated worldwide from nuclear power every year is produced in light-water reactors (LWRs) using low-enriched uranium (LEU) fuel. About 10 metric tons of natural uranium go into producing a metric ton of LEU, which can then be used to generate about 400 million kilowatt-hours of electricity, so present-day reactors require about 70,000 metric tons of natural uranium a year. According to the NEA, identified uranium resources total 5.5 million metric tons, and an additional 10.5 million metric tons remain undiscovered—a roughly 230-year supply at today's consumption rate in total. Further exploration and improvements in extraction technology are likely to at least double this estimate over time. Using more enrichment work could reduce the uranium needs of LWRs by as much as 30 percent per metric ton of LEU. And separating plutonium and uranium from spent LEU and using them to make fresh fuel could reduce requirements by another 30 percent. Taking both steps would cut the uranium requirements of an LWR in half. Two technologies could greatly extend the uranium supply itself. Neither is economical now, but both could be in the future if the price of uranium increases substantially. First, the extraction of uranium from seawater would make available 4.5 billion metric tons of uranium—a 60,000-year supply at present rates. Second, fuel-recycling fast-breeder reactors, which generate more fuel than they consume, would use less than 1 percent of the uranium needed for current LWRs. Breeder reactors could match today's nuclear output for 30,000 years using only the NEA-estimated supplies.

#### **In Europe, nuclear energy remains central to energy security – fast reactors can solve for sustainability, safety, and environmental concerns. Schenkel ’09.**

R. Schenkel " FAST REACTOR RESEARCH IN EUROPE: THE WAY TOWARDS SUSTAINABILITY." Fast Reactors and Related Fuel Cycles: Challenges and Opportunities (2009): n. pag. Web

reaching initiatives from promoting energy efficient light bulbs and cars to new building codes, carbon trading schemes, the development of low carbon technologies and greater competition in energy markets. Nuclear energy remains central to the energy debate in Europe. One third of EU electricity is produced via nuclear fission, and eight new reactors are under construction. Traditionally non-nuclear countries are manifesting an interest in building nuclear power plants while the clock is ticking down on Belgium, Germany and the UK's decision to renew or close existing nuclear infrastructures. Sustainability in nuclear energy production is ensured in the medium term due to the large and diverse uranium resources available in politically stable countries around the world. The quantities available with high probability ensure more than hundred year of nuclear energy production. This extrapolation depends however on the forecast for the future nuclear energy production. The use of fast neutron breeder reactors would lead to a much more efficient utilisation of the uranium, extending the sustainable energy production to several thousands of years. The presentation will outline the fast reactors of the new generation currently being developed within the "Generation IV" initiative. Broad conclusions of the presentation will be that: � There is a growing nuclear renaissance in Europe for good reason; � Nuclear energy is a green and sustainable option for Europe and indeed the world's energy needs; � Nuclear energy is a competitive energy that makes economic sense; � Nuclear fission reactors have a safety and environmental track record that is second to none, yet public misperceptions persist and must be tackled; � Waste management solutions exist while new developments hold great promise; � The evolution and promise of nuclear technologies must also be examined against the costs and risks in a balanced approach; � Research on fast neutron reactors is being strengthened in Europe, under the umbrella of the Generation IV International Forum. European coordination is entrusted to the Joint Research Centre.

#### Current electricity generation mostly stems from LWRs (in the nuclear field), and at the current path is expected to grow. This will make sustainability a larger problem – FNRs can solve for both resource usage AND waste disposal. Carbonnier ‘09

Carbonnier, J. L. "ADVANCED AND INNOVATIVE REACTOR CONCEPT DESIGNS, ASSOCIATED OBJECTIVES AND DRIVING FORCES." Fast Reactors and Related Fuel Cycles: Challenges and Opportunities (2009): n. pag. Web.

Nuclear Energy appears more and more as an option which cannot be ignored, in the quest for solutions that meet the increasing world energy demand all while reducing the release of green house gases. Today's world installed nuclear capacity amounts to some 370 GWe, which contributes to about 15% of the world's electricity generation. In the next decades, nuclear electricity production will mainly originate from third generation light water reactors (LWRs), which are safe, reliable and efficient. To date, LWRs consume less than 1% of natural uranium, and the issue of uranium resources will appear more acute as the size of the LWR fleet grows bigger. As for the spent fuel, some countries have recourse to an open cycle, while others have adopted a closed cycle with spent fuel treatment and partial recycling. Open cycle leads to storage then to geological disposal of the bulk of spent fuel, which is an option that does not seem compatible with a strong increase of the nuclear fleet in a large number of countries. Closed cycle allows for the sorting out of the different components of the spent fuel: uranium and plutonium can be recycled once in LWRs, which enables a 20 to 30% saving of natural uranium consumption, the ultimate wastes being conditioned within glass to be stored under simpler and safer conditions. However LWRs do not allow for plutonium multi-recycling: used MOX fuel can be stored for further recycling, in fast spectrum rectors, of the plutonium it contains. Fast Neutron Reactors (FNRs) enables the expansion of nuclear energy all while meeting sustainable development criteria: resource saving and more complete waste management. Many countries are interested in this promising reactor type: sodium cooled FNRs, for which extensive feedback experience exists, corresponding to tens of reactors worldwide, is the most mature technology, heavy metals cooled FNR (lead or lead-bismuth eutectic) may be an alternate to sodium, gas cooled FNR (helium) may gather advantages of FNR and other applications than electricity generation. The capacity to manage waste is characterised by the possibility to recycle indefinitely plutonium and maybe minor actinides, which are, after plutonium, the main contributors to long-term radiotoxicity. Plutonium multi-recycling is characterized by the breeding ratio, which represents the ratio between the plutonium generated from uranium 238 and the plutonium consumed. With a breeding ratio smaller than 1, a FNR operates in burner mode, i.e. it is used to consume plutonium and burn the other actinides produced in a LWR fleet; if the breeding-ratio is greater than 1, the FNR operates in breeder mode, and has the potential to be self sufficient with no recourse to a LWR fleet; the greater the breeding ratio, the greater the capacity of the reactors to provide fuel not only for their own future operation, but also to start new FNRs. Both modes are not antagonistic, those countries which favour a burner mode could move towards a breeder mode when they consider the timing appropriate: economic competitivity of FNRs, increase of uranium cost…

#### Fast Reactors are cheaper than current thermal reactors in terms of cost, and continued production of fast reactors promise to meet the energy needs of the 21st century. Orlov ‘09

Yu. I. Orlov. " LIQUID METAL COOLANT TECHNOLOGY FOR FAST REACTORS." Fast Reactors and Related Fuel Cycles: Challenges and Opportunities (2009): n. pag. Web.

As the result of comprehending (already at the Kurchatov Institute) the causes for the unsuccessful early experience, in the 1980s the author gave up the Fermi-originated concept of the «FR-breeder» started on the Pu from thermal reactors and embarked on the development (at NIKIET) of the BREST «inherent-safe FR» of a moderate power rating with BR~1 to operate on enriched U or Pu. The consumption of U (and the separation work) to start the FR on enriched U is considerably below that for thermal reactors-generated Pu, and the FR natural safety properties with respect to accidents, wastes and proliferation resistance once the adequate technology is selected (nitride fuel of an equilibrium composition, on-site «dry» processing of fuel, Pb in place of Na) also make large NPPs much cheaper. High rates of Pu breeding are therefore unnecessary, while U is used in full with BR���������������� -200 times as effectively as in thermal reactors, so inexhaustible low-grade ores suit as well. Fitting FRs with a Th-blanket in future will also provide Th- 3U fuel for FRs of smallsized NPPs for local needs. Still, the prime task of nuclear power will remain generation of electricity at large NPPs, where it is profitable to use FRs in closed fuel cycles. The growth of nuclear power will entail an increase in the share of electricity in total energy consumption (currently ~1/6). The BREST technology in closed fuel cycle has been studied since the 1950-1960s for FRs and nuclear submarines, but has not been employed in FRs as these have been no longer built. It will be for another 20 years or so that nuclear power will continue to rely on TRs built in the 1940-1950s for military applications and converted later to electricity production, still failing to offer solutions to its problems. It can be expected that FRs will be built during this period to solve all of the nuclear power problems, including fuel balance, safety and economics, and, ultimately, the power problems proper. By overcoming the inertia of stereotypes and the decades of stagnation in thermal reactors of the 1940-1950s and by building new FRs, we will be able to meet the challenges the world is expected to face in the 21st century and solve the fuel and energy problems. The estimates given in the report indicate to the feasibility of promoting the evolution of nuclear power up to ~10 5 GW(t), which will not to cause a major unbalance with the ~10 8 GW falling onto the Earth. Nuclear power of such a scale will have the capability to provide the energy supply for the population of the globe at the level of advanced countries with no further limits in terms of cheap fuel resources.